

Keen (W. W.)

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IN THE NECK; WITH A RÉSUMÉ OF THE
TWO PRIOR RECORDED CASES AND
TWO ADDITIONAL CASES.

BY

W. W. KEEN, M.D.,

*Professor of the Principles of Surgery and of Clinical Surgery, Jefferson Medical
College, etc., Philadelphia.*

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WHEN we consider the frequency with which operations are done on the left side of the neck in the vicinity of the junction of the jugular and subclavian veins for the removal of enlarged glands, for tumors, for goitre, etc., and of stab and other wounds, it is surprising that there are not a number of instances of wounds of the thoracic duct. The danger of wounding it may be greatly increased by the fact that Dieterich (Henle's *Anatomy*, 1876, iii. 453) has found the arch of the duct as much as $5\frac{1}{2}$ cm. (over 2 inches) above the top of the sternum and touching the thyroid gland. Yet, so far as my investigations have gone, I have only been able to discover two cases of wound of the cervical portion of the duct reported in surgical literature. To these to-night I add two more, one of my own, and another the notes of which have been kindly furnished me by Dr. A. M. Phelps, of New York.

Even in war, wounds of the duct in any part of its course are practically unknown. In neither the Italian war of 1859, the Crimean war, nor our own late civil war, is there a single instance recorded.

CASE I. (Cheever's case.)—Dr. Cheever reports in the *Boston Medical and Surgical Journal* for 1875, p. 422, the case of a tumor of the neck, during the removal of which "the subclavian vein and a large vessel near the internal jugular were both wounded. The distended veins mixed up with the friable glandular growth gave way repeatedly under the forceps and ligature. At this time occurred a new source of difficulty. A transparent, viscid, coagulable, and colorless fluid ran out from the tumor and from the lower corner of the wound in quantities as large as an ounce at a time, some six separate times. Together with the dark venous blood, this fluid constantly obscured and filled the bottom of the neck whenever pressure by the finger or sponges was taken off."



The inner two-thirds of the clavicle were then removed. "The subclavian artery was sought and pushed aside and an aneurism-needle passed between it and the vein, first out toward the shoulder and a ligature tied; and second, close to the sterno-clavicular articulation, where the needle and ligatures surrounded the venous trunks at or upon their junction in the left vena innominata. The artery was not wounded nor tied. All bleeding now ceased, but the transparent fluid still oozed out moderately. The wound was lightly packed with sponges and ferric alum; no hemorrhage occurred, and the transparent fluid did not soak through the sponges." The patient died from shock and exhaustion, thirty-six hours after the operation. "No formal autopsy was made, but an examination of the wound showed the subclavian vein tied externally, and also at the junction of the internal jugular and subclavian. The remains of the tumor extended two inches below the clavicle, but were enucleated without piercing the pleura. This fragment of tumor had incorporated into itself several venous trunks or sinuses caught and entangled in the gradual agglomeration of glands. There was no opening into the pleura, no sac running down into the thorax or axilla, no cyst in any direction. The source of the transparent effusion could not be traced. There would seem to be but little doubt that this fluid was lymph from a large branch of the lymphatics in the tumor, or more probably from the thoracic duct where it arches over to join the left subclavian vein. In contact with, if not surrounded by, the glandular enlargement, its thin and transparent walls were readily wounded in trying to remove the lower part of the tumor. No other source for the clear fluid could be found, there being neither cyst, hydrocele of the neck, nor pleural effusion to account for it. The fluid under the microscope exhibited no cells save a few stray blood corpuscles. The patient having fasted for twelve hours before the operation, there would be little, if any, of the milky emulsion of chyle in the duct.

"The fluid poured out of this wound coagulated after contact with the air in a firm jelly, just as blood coagulates. This no doubt was due to its fibrin. Its large quantity pointed to a considerable duct as its source, although it must be borne in mind that the whole lymphatic system of the neck was probably vastly enlarged, and secreted great quantities of lymph. Very probably the waste of nutritive plasma by this leakage of lymph in the wound hastened the exhaustion of the patient, and, if due to a wound in the thoracic duct, would have precluded his recovery."

CASE II. (Boegehold's case, *Arch. f. klin. Chir.*, 1893, vol. xxix. p. 443.)—In March, 1880, Wilms extirpated a tumor as large as a fist from the left side of the neck of a stout man forty-five years of age. In the course of the operation Wilms gradually neared

the junction of the subclavian and jugular veins. As he was carefully scraping the tissue with a sharp spoon, suddenly there poured out over the operation field a stream of whitish fluid the diameter of a straw, which mingled with the rather freely flowing blood. This fluid could not well be anything else than chyle, for a wounded lymph vessel would have given exit to a clear, or at the most a slightly yellowish, but not whitish, fluid. There was no abscess nor any purulent pleurisy. After this wound of the thoracic duct, the extirpation of the tumor was terminated at once. The milky fluid no longer escaped, and on account of the considerable hemorrhage the idea of securing it in the depth of the wound was abandoned. The wound was then packed with salicylic wool and an antiseptic bandage applied. The packing was removed the next day without any further appearance of the chyle. The patient recovered without incident, and six months afterward died, presumably from pulmonary metastasis of the carcinoma.

CASE III. (Case of Dr. A. M. Phelps, of New York; personal communication.)—June 4, 1893, at the Mary Fletcher Hospital, Burlington, Vt., Dr. Phelps operated on a malignant tumor of the left side of the neck. "It was found that the jugular vein passed through the tumor, and this necessitated the removal of three inches of the jugular, near its junction with the subclavian. The tumor extended downward underneath the subclavian vein and involved the deep muscles of the neck. The wound was dressed four days later. There had been a constant profuse discharge, which at first was supposed to be serum, but its color, like that of skimmed milk, and its source from a single point in the wound, as well as its quantity, soon forbade that presumption. I estimate that about three pints a day had been lost. It was sufficient to saturate daily ten or fifteen ordinary bed-sheets folded in a number of thicknesses, in addition to saturating the surgical dressings. The man was rapidly losing flesh. A consultation of staff was held on June 11th, and the consensus of opinion was that the thoracic duct had been severed. The point of a probe the size of a large knitting-needle inserted at the point of evacuation entirely stopped the discharge. The point from which the liquid issued was caught by forceps, which were allowed to remain in place three days. The patient gained a pound a day after the discharge was stopped, and made an excellent recovery."

The duct cut, in his opinion, was one of the divisions or ramifications of the thoracic duct, but the staff thought that the main trunk had been severed.

The fourth case is my own.

CASE IV.—Miss S., aged twenty years, was first brought to me in November, 1892, by Dr. Melcher, of Mt. Holly, N. J. There was a small enlarged gland on the left side of her neck above the

clavicle, a scar at a corresponding point on the right side, and another scar at the upper border of the right breast. From these two places showing scars, Dr. Melcher had removed glands which were undoubtedly tubercular. Just below the right clavicle and a little external to its centre was a tumor, evidently deep in the apex of the right axilla, firmly attached so as to be practically immovable, and extending, so far as could be ascertained, half way or more from the clavicle to the axillary border. It first appeared about a year ago. I judged it to be a series of enlarged glands, probably attached to the vessels. She had occasionally tingling and numbness in the right arm, and slight cedematous swelling. Soon after she was here Dr. Melcher made an attempt to remove the tumor, but the hemorrhage was so great as to deter him, and he closed the wound, from which she made a good recovery.

Operation, Jefferson Hospital, January 28, 1893. I made an incision almost vertically in the axis of the body, from the clavicle about four inches downward. I came upon the tumor as soon as I was through the great pectoral muscle. Finding its extent, especially toward the axilla, greater than it appeared from the outside, I made two transverse incisions, converting the whole incision into a cross. I first dissected from the clavicle downward. I found the tumor adherent, not to the clavicle, but to the second rib and the costo-coracoid membrane. With a good deal of care and difficulty I was able to separate the upper border of the tumor from the clavicle and work my way downward and also outward toward the vessels. In a few moments I saw a part of the tissue collapse with inspiration, and I recognized that this was the subclavian vein.

I was finally able to remove the entire tumor, but only after one of the most difficult and tedious dissections I ever made. The tumor was a mass of enlarged glands extending three-quarters of the way around the axillary vessels, the upper border alone being free. It was with the greatest difficulty that I could separate the tumor from the vein to which it was especially adherent, but I finally succeeded. The dissection took over an hour and the whole operation was nearly an hour and a half long. I buttonholed the axillary skin at its posterior border and carried out a drainage-tube, otherwise closing the wound and dressing it as usual. The hemorrhage was moderate, not over eight or ten vessels requiring ligation.

February 11, 1893. Her recovery was rapid and gratifying. The highest temperature was 99.8° . The drainage-tube was removed in forty-eight hours, and the sutures on the third, fifth, and seventh days. On the eighth day she went home perfectly well.

Dr. Kyle reported as follows on the specimen: "Frozen sec-

tions from this specimen showed it to be tubercular. The sections were so arranged as to include portions of dense tissue, also the caseous mass. Macroscopically and on cutting through the specimen it resembled lympho-sarcoma, which appearance could be produced by the enlargement of the gland, which would cause pressure on intervening tissue, giving it that peculiar fibrous appearance. By the methyl-violet and blue stain the tubercular condition was easily recognized."

She returned to me December 12, 1893, with enlarged glands in the neck on both sides, just above the clavicles and in both axillæ, especially the right one. These glands were high up in the axilla on both sides and were apparently (especially on the right side) very adherent. In the neck the glands were rather peculiar, in that while they were very perceptible as tolerably large, nodular masses, evidently composed of a number of glands, the inner portion on both sides was soft, markedly lobular, and apparently contained some fluid. Those on the left side of the neck were larger and gave her a good deal of annoyance and pain, somewhat resembling in this respect those in the right axilla. I advised her therefore to have them removed.

Operation, Jefferson College Hospital, December 15, 1893. Present, Prof. Clayton Parkhill, of Denver, and Drs. Hearn and William J. Taylor. Drs. J. Chalmers Da Costa and Weaver assisted me. When the patient was etherized and recumbent, I saw a marked change in the condition of all the tumors. The one in the left axilla just below the clavicle could not be found. That on the right side was apparently very much diminished, as were both of those in the neck, the right one being partially perceptible and the left moderately so. The soft, fluid part of the cervical swellings had entirely disappeared.

The right axilla was opened by an incision passing along the border of the tendon of the great pectoral muscle. The operation was tedious and very difficult mechanically, by reason of the extensive and very dense adhesions from the peri-adenitis and from the former operations. The adhesion to the axillary vein was particularly solid and sometimes was almost as tough as though made of leather. However, after very slow, careful, and patient dissection I was able to get out a large mass of glands.

Having finished the dissection of the glands in the right axilla, I next made an incision above the left clavicle to remove the glands there. There was a great deal of peri-adenitis, creating very firm adhesions, especially downward and inward toward the junction of the left internal jugular and subclavian veins, both of which were laid bare nearly, not quite, to their junction. I was carefully dissecting these adhesions away with Allis's blunt dissector, when suddenly I made a small opening in what was

apparently an adhesion, and instantly there welled out from it a perfectly limpid fluid. At first I thought I had opened a cyst; but, on observing that the fluid escaped continuously and with a very evident respiratory rhythm, and that the fluid apparently flowed from a tear one-fourth of an inch in length, from a tube about one-eighth of an inch in diameter, it occurred to me that it was either one of the dilated left lymphatic ducts just before their entrance into the thoracic duct, or that, more likely, it was the thoracic duct itself. About two ounces of fluid escaped in all. I sucked up a little of it with a hypodermatic syringe. It coagulated in a few minutes. Dr. Da Costa suggested that the distinction between the two fluids, *i. e.*, from the lymphatic and the thoracic ducts, could be made by the fact that the fluid in the thoracic duct should be milky, but as she had taken no food since the previous evening (eighteen hours) this gave no help. Against its being the thoracic duct was the fact that it was just behind the upper border of the clavicle, and therefore lay too high for the thoracic duct; but as the glands were being dragged upward, this objection I felt was not valid. Also, although I could introduce a grooved director into the tube from which the fluid was escaping, the director only entered about one-half to three-quarters of an inch when it met some obstacle. In such a locality and in such a novel experience, I did not care to enlarge the boundaries of science at the possible expense of my patient, and hence I decided to desist from further exploration and remedy the apparent mischief at once. Accordingly I closed the opening by the pressure of one finger, and carefully removed the glands, which were almost entirely loosened at the moment of the accident. Then I seized the two edges of the opening with forceps, and by means of the finest Hagedorn semicircular needle and fine silk I closed the wound. Some little leakage still took place. There was also a little of a similar fluid from the upper part of the wound, but it seemed a general oozing rather than from any distinct vessel. The remainder of the operation was completed with ease, although it was extraordinary what a large mass of glands I removed, in view of the almost utter inability to perceive them when she was etherized and recumbent. Nothing was found to account for the soft and apparently fluid part of the tumor noticed when she was first examined. This soft mass was at least one and one-half inches external to the site of the opening into the thoracic duct and nearly as much above it.

A drainage-tube was inserted into the wound, but was removed after five hours, having served its function of conducting off most of the bloody wound-fluids, and I feared that its retention would be followed by a lymphatic fistula. Any escape of lymphatic fluid from the thoracic duct I thought should be repressed as

quickly as possible by absolute closure of the wound. During the five hours the amount of wound-fluids was very large for so small a wound, amounting to nearly a pint, and its light color showed that the small amount of blood was diluted with a great deal of clear fluid. The dressing the next day was partially saturated by probably an ounce or two, and after that was dry.

On the eighth day after the operation, having made an absolutely uneventful recovery, she went home. Not the slightest evidence of trouble appeared in the wound in the neck, neither swelling, redness, nor pain. Her weight on December 11th, four days before the operation, was 106 pounds and eight days after it, in about the same clothing, 103 pounds. Her highest temperature was 99.8° , on the evening of the operation. The following table shows her weight since the operation :

	Weight.
December 28, 1893	100 pounds.
January 6, 1894	101 “
“ 12, “	$100\frac{1}{2}$ “
“ 19, “	$100\frac{3}{4}$ “
“ 26, “	$100\frac{3}{4}$ “

March 15, 1894, same weight. Her cough troubles her considerably.

Dr. Kyle reported that in the fluid there were many lymphocytes or lymph-corpuscles of different sizes ; some few were slightly granular, and there were many fat- or oil-globules, small in size, but large in number. The macroscopic appearance of the fluid was slightly opaque.

REMARKS.—First. The anatomy of the thoracic duct. As has been shown here to-night in the beautiful dissections of Mr. Ward Brinton, the thoracic duct does not always empty by a single mouth at the junction of the left jugular and subclavian, but is apt sometimes to break up into two or three ducts or even into a delta, some of the branches emptying into each of these large veins, and, as Dr. Phelps finds from his dissections of the duct, into other deep veins of the neck. Verneuil (*Le Système Veineux*, 1853) states that Boullard in twenty-four cases found it to empty by one mouth eighteen times, by two mouths three times, by three mouths twice, and finally once by six mouths, of which two opened into the subclavian, two into the jugular, and one each into the external jugular and the vertebral veins. Lacauchie (Henle, l. c.) gives an instance of four terminal canals. In twenty-one injections of the duct Boegehold found that in two cases it divided at its anastomosis with the veins into three or four branches, and in one case, about two inches before its termination, a branch as large as a straw passed to the subclavian, the main trunk empty-

ing at the angle between the subclavian and the jugular. It is, therefore, possible in all these cases of wound that not the main trunk, but one of these branches—perhaps, as in Boegehold's case, a branch as large as a straw—was injured. Bayford (Boegehold, p. 447) records one case of dislocation of the thoracic duct from a curvature of the spine, which might increase materially the possibility of its being wounded should an operation have to be done in such a case. Boegehold (p. 455) also quotes a case from Scherb of the partial obstruction of the duct by a calculus. The occasional great height of the final curve of the duct in the neck has already been mentioned.

Secondly. The character of the fluid. There could be no possibility that the source of the fluid was other than the thoracic duct in Boegehold's and Phelps's cases, as, from its milky color, the fluid was evidently chyle. In the other two cases the fluid has been so clear that it resembled serum. I do not know the relation of the hour of operation to the hour of the last meal in Cheever's case. In my own case the patient, having had two prior operations, and suffering from ether nausea, had refused to eat any breakfast whatever, and when I operated, at twelve o'clock noon, it was eighteen hours since she had eaten the previous meal. The quantity of the fluid in Phelps's case was very extraordinary, and leaves no doubt that it could only have been from the thoracic duct. In Cheever's case and my own the quantity and character of the fluid make it reasonably certain that it was from the duct, but it is not so demonstrably sure as in the other two cases.

Third. Treatment. Cheever's case was so speedily fatal from other reasons that no inferences can be drawn from it. In Boegehold's case packing was sufficient to arrest the flow and the patient recovered. In Phelps's case pressure-forceps arrested it entirely. In my own case the suture of the vessel was perfectly feasible, and the result was most satisfactory. It seems to me clear that if this procedure can be adopted it should always be done. I very anxiously watched the weight of my patient from week to week for the first few weeks after the operation. Then, finding that she was not losing ground, it was clear to me that she had permanently recovered from the accident, which at first caused me much anxiety.

Fourth. Experimental researches. Boegehold, so far as I know, is the only one who has tested the question by experiment. In his first two experiments, in dogs, he exposed the thoracic duct at its entrance into the veins and wounded it with scissors. Pneumothorax followed, but disappeared within five days. Eight days after the accident the dogs were killed. No trace of pleurisy was found, and the duct at the level of the fourth dorsal vertebra was surrounded with a thin whitish-red clot of fibrin. The duct was

divided for over one-fourth of its circumference. In the next three experiments the duct was cut obliquely. On the following day the dogs were evidently sick, with a rapidly increasing frequency of respiration. On the evening of the third or fourth day they died, and at the autopsy the pleural cavity was found full of chyle. The cause of death was compression of the heart and lung from effusion of chyle. In the sixth and seventh experiments he placed a canula in the duct. This was followed by suppurative pleurisy, with death respectively on the fourteenth and tenth days. At the autopsy the pleura was found covered with fibrinous clots, but as the fever had subsided on the fifth day, he ascribed death to the loss of chyle. In the eighth experiment he ligated the ends of the duct in the neck. On the fourth day he inserted his finger into the pleural cavity. The duct was easily found as it was distended with chyle. He wounded it slightly with scissors, and seventy-two hours later the dog was killed. The duct and the receptaculum were distended with chyle, and at the site of the wound a small red fibrinous clot was found. Very little chyle had escaped on account of the smallness of the wound.

As a result of his experience he thinks that the complete integrity of the duct for the support of life is not absolutely necessary. He gives a number of instances of complete obliteration or compression of the duct without any symptoms. The collateral circulation of the lymph seemed to be established, and Schmidt and Mulheim have shown experimentally that the closure of the duct in dogs, in whom the canal is always single, did not affect either the digestion or the absorption of albuminous matter. An injury followed by closure of the duct, therefore, is not necessarily fatal. The danger is that if the duct is not closed, either compression of the lungs and heart from the constantly augmenting accumulation of chyle in the pleural cavity will prove fatal, or that the loss of nourishment will be lethal if it escapes externally. Wounds of the duct seem to be entirely capable of healing. Should the heart and lungs be compressed, clearly the pleural cavity should be opened in order to avoid the immediate danger of death from compression, as is shown by Kirchner's case (*Arch. f. klin. Chir.*, 1885, p. 156). This seems to have been an undoubted and severe rupture of the thoracic duct within the thorax, and yet was followed by recovery. It shows that even rupture of the duct may not necessarily be fatal.

A little girl, nine years of age, healthy although not very strong, was pushed violently against a window-sill, injuring her at the level of the third rib. Marked orthopnoea, with cyanosis and sweating, and dilatation of the nostrils followed in the course of two weeks. The right half of the thorax was broader than the left up to the level of the spine of the scapula and the third rib.

The heart was pushed to the left, and the liver extended two fingers' breadth below the border of the ribs. The temperature was normal. The right chest was punctured in the fifth intercostal space and a litre of fluid resembling milk was poured out. Examination by the microscope showed undoubtedly that it was chyle. Ten days later the dyspnoea was so great that puncture was again contemplated, but under warm baths and slight purgation by senna the improvement was such that puncture was not done a second time, and complete recovery followed. In six months the child was better than prior to the attack.

Kirchner states that, even including some uncertain cases, there are but seventeen on record of injury of the thoracic duct, either in the neck, chest, or abdomen; six resulting in chylous ascites; nine in chylo-thorax; one of hydrops lacteus from the collection of lymph in the mediastinum; and finally, the case of Boegehold, the only instance he gives of injury in the neck. The three additional cases I have reported here bring the total number up to twenty, and of wounds in the neck alone to four.

Busey (*Trans. Assoc. Amer. Phys.*, 1889, vol. iv. p. 76) refers to a number of cases of injury to peripheral lymphatics by bleeding, etc., and also the effusion of chyle into the thorax, abdomen, tunica vaginalis testis, etc. In the discussion Welch said: "I do not think that the mere occlusion of the thoracic duct, still less obstruction to the venous flow in the subclavian veins, is followed by serious interference with the flow of lymph and chyle. I have found the thoracic duct completely occluded by a tuberculous thrombus in a case of acute miliary tuberculosis without any such effect."

The pressure in the thoracic duct is not very high. According to Weiss, in the neck it reaches from 9 to 15 mm. of mercury.

